

In re Patent Application of:
DENYER ET AL.
Serial No. **09/891,134**
Filing Date: **JUNE 25, 2001**
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REMARKS

The Applicants would like to thank the Examiner for the thorough examination of the present application. The specification has been amended to correct a noted grammatical error. The arguments supporting patentability of the claimed invention are presented below.

I. The Independent Claims Are Patentable

The Examiner rejected independent Claims 12 and 16 over the Dierickx et al. patent, and independent Claims 21 and 26 over the Hurwitz et al. patent in view of the Dierickx et al. patent. The rejection of all the independent claims is addressed below.

Independent Claim 12, for example, is directed to a method of operating a solid state image sensing array comprising a plurality of active pixels. The method comprises resetting each pixel, reading a first output from each pixel after a first period of time to obtain a first set of image data having a first dynamic range, and reading a second output from each pixel after a second period of time and without resetting each pixel to obtain a second set of image data having a second dynamic range. The first and second sets of image data are combined to obtain a resultant set of image data having a dynamic range different from the first and second dynamic ranges.

The method in accordance with the claimed invention advantageously performs multiple read operations within an integration period (i.e., before resetting the pixels). In other words, two separate reading operations are performed within the same integration period to obtain two different

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sets of image data, and then the two different sets of image data are combined to provide a resultant set of image data having an improved dynamic range.

Independent method Claim 16 is similar to independent method Claim 12. Independent method Claim 16 comprises resetting and immediately reading a preliminary output from each pixel, and reading a first output from each pixel after a first period of time. Independent device Claim 21 is directed to a solid state image sensor, and is similar to independent method Claim 12. Likewise, independent device Claim 26 is directed to a solid state image sensor, and is similar to independent method Claim 16.

The Examiner cited the Dierickx et al. patent as disclosing a method of operating a solid state image sensing array comprising a plurality active pixels (FIG. 1A), resetting each pixel (FIG. 5, "reset"), reading a first output from each pixel after a first period of time to obtain a first set of image data having a first dynamic range (FIG. 5, "sample" and "signal"), and reading a second output from each pixel after a second period of time and without resetting each pixel to obtain a second set of image data having a second dynamic range (FIG. 5, "reset", "sample" and "signal"). The Examiner further states that the first and second sets of image data are combined to obtain a resultant set of image data having a dynamic range different from the first and second dynamic ranges (column 7, lines 23-42).

The Applicants respectfully submit that that Examiner has mischaracterized the Dierickx et al. patent. In particular, Dierickx et al. discloses a single readout scan that collects a double (or multiple) linear response in one

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image scan - as compared to multiple reads in one image scan to obtain the first and second sets of image data. Reference is directed to column 3, lines 12-25 of the Dierickx et al. patent, which provides:

"According to the present invention, there is no limitation to the amount of collected charges in none of the integrated periods. The signal collected during the first period is memorized by a switch which shortly closes and opens between the period. Using the second period, there is no electrical contact between the output node and the memory element. The switch can thus be in the same state in both periods of time. After a second period, there are thus two charge packets, each obtained during a different time. In order to read-out, these two charge pockets are then combined into the read-out signal. This combination is done, e.g., by adding or subtracting these charge packets or by adding or subtracting them in the circuitry external to the sensor." (Emphasis added.)

The Dierickx et al. patent fails to disclose multiple reads being performed between successive resets. Instead, a single readout scan collects a double (or multiple) linear response in one single image scan. This statement is further supported by the following reference to column 7, lines 12-25 of the Dierickx et al. patent, which provides:

"At the end of the integration period, the memorized value on the capacitor C is sampled ("a"), then the sample switch is shortly opened, and the recent potential on the photodiode output node is sampled ("b"). After reset, the reset value of

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the pixel is sampled, which might be useful for offset correction, correlated doubling sampling, etc." (Emphasis added.)

In sharp contrast, the claimed invention includes reading a first output from each pixel after a first period of time, and then reading a second output from each pixel after a second period of time. Consequently, at least one extra read operation per integration period is performed. This is different from the double (or multiple) linear response obtained within a single readout scan, as disclosed by the Dierickx et al. patent.

Therefore, the Applicants submit that independent Claim 12 is patentable over the Dierickx et al. patent. Independent Claim 16 is similar to independent Claim 12. The Applicants also submit that independent Claim 16 is patentable over the over the Dierickx et al. patent.

In the rejection of independent Claims 21 and 26, the Examiner further cited the Hurwitz et al. patent. The Examiner cited the Hurwitz et al. patent as disclosing in FIGS. 1 and 2 a solid state image sensor comprising a plurality of active pixels **2**, a vertical shift register **20** connected to rows of the plurality of active pixels, and a horizontal shift register **22** connected to columns of the plurality of active pixels. Nonetheless, the Hurwitz et al. patent fails to provide the noted deficiencies with respect to the Dierickx et al. patent. Therefore, the Applicants submit that independent Claims 21 and 26 are patentable over the Hurwitz et al. patent in view of the Dierickx et al. patent.

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In view of the patentability of independent Claims 12, 16, 21 and 26 as discussed above, their respective dependent claims, which recite yet further distinguishing features, are also patentable, and require no further discussion herein.

II. Dependent Claims 14, 18, 23 and 28 Are Patentable For Alternate and Independent Reasons

The Examiner rejected dependent Claims 14, 18, 23 and 28 directed to the first and second periods of time being selected to be an integer multiple of a predetermined lighting flicker period. The Examiner has taken the position that these dependent claims are not patentable based upon the Dierickx et al. patent in combination with the prior art image sensors discussed in the Applicants' specification.

The Examiner correctly notes that the Dierickx et al. patent fails to disclose exposure periods being an integer multiple of a predetermined lighting flicker period. The Examiner cited the Applicants' admitted prior art as disclosing CMOS image sensors suffering from horizontal banding interference when the exposure time is not an integer multiple of a light flicker period. The Examiner has taken the position that it would have been obvious to make the integration times of the image sensor in Dierickx et al. integer multiples of a lighting flicker period to correct horizontal banding interference in the image.

While the Applicants' specification states that the exposure period of an image sensor can be set to be equal in time to an integer multiple of the lighting flicker period, there is no suggestion that the time periods as defined in

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Claim 12, i.e., periods between successive reads within an integration period, could be set according to the same criteria.

The prior art disclosed in the background section of the Applicants' specification requires that an image sensor's exposure period is equal to an integer multiple of the lighting flicker period. If one skilled in the art were to consider the Dierickx et al. patent, it is submitted that there would be no reason to further make the time between each read operation (or charge collection) within the integration period an integer multiple of the lighting flicker period.

In particular, Dierickx et al. teaches that the response given by each of the first and second signals is assessed, and to time them so that a good double linear response can be achieved. The Applicants respectfully submit that the requirement that the overall exposure period has to be equal to an integer multiple of the lighting flicker period as a global requirement would not be useful for the overall objective of obtaining a final signal with an increased dynamic range.

The Applicants submit that dependent Claim 14 is patentable over the over the Dierickx et al. patent in view of the prior art disclosed in the background section of the Applicants' specification on this alternate and independent basis. Dependent Claims 18, 23 and 28 are similar to dependent Claim 14, and it is submitted that these claims are also patentable.



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CONCLUSION

In view of the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Justin [Signature]